

An Event-Based Comparison of Two Raingages: Implications for Hydrologic Models

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OVERVIEW

Introduction

Analog and Digital Raingage Event-Based Comparison

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Introduction: Background

As sensor technologies improve with more precise and accurate techniques to measure hydro-meteorological properties, older technologies are replaced.

Many of these older technologies have been in place for decades and long term databases from networks of these sensors are the basis for much hydrological modeling and analysis.

At Walnut Gulch Experimental Watershed the technology for raingages was the same for over forty years and some individual raingages were in place the entire time.

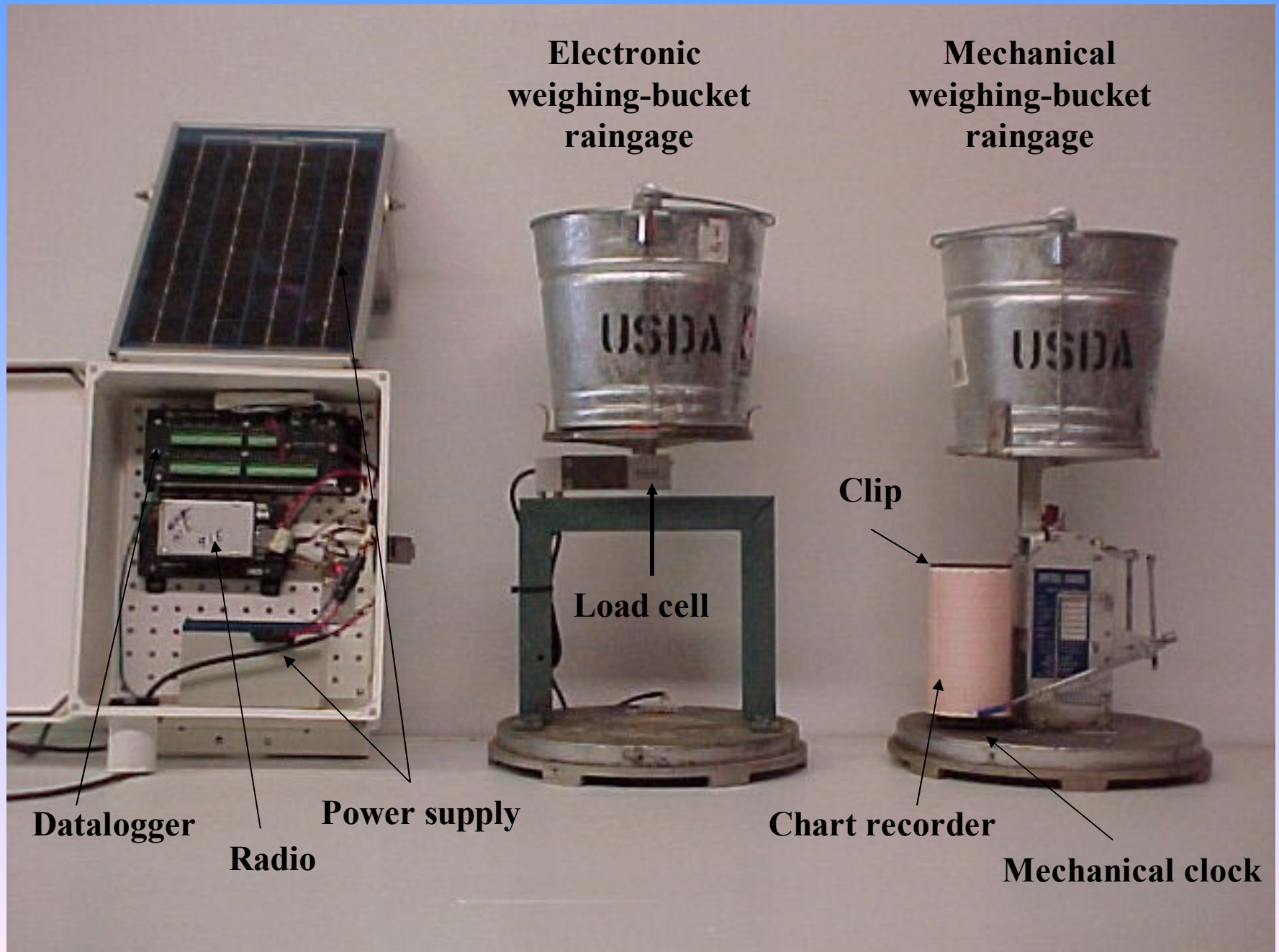
Introduction: Background

SWRC has transitioned from mechanical-weighing, analog-recording raingages to electronic-weighing, digital recording gages.

In the process of converting all raingages at both the Walnut Gulch Experimental Watershed and the Santa Rita Experimental Range, SWRC maintained nine paired analog and digital raingages from 2000 through 2004 to develop comparative precipitation event statistics.

The analog raingages in this study are part of the long-term network.

Introduction: Raingages



Introduction: Analog underestimation of days with rain

Previous studies have shown that analog chart recorders miss many small events and underestimate the number of days with rain.

A preliminary study recently completed confirmed this for analog gages during the 5 year comparison period.

The underestimation of the number of days with rain will have implications for stochastic daily weather generator model parameters (wet and dry day transition probabilities and the mean amount of rain on a wet day) and simulations of daily weather variables.

Introduction: Analog overestimation of peak intensities

Previous work has shown that the minimum time interval

to be read from a 24-hour chart is 5 minutes.

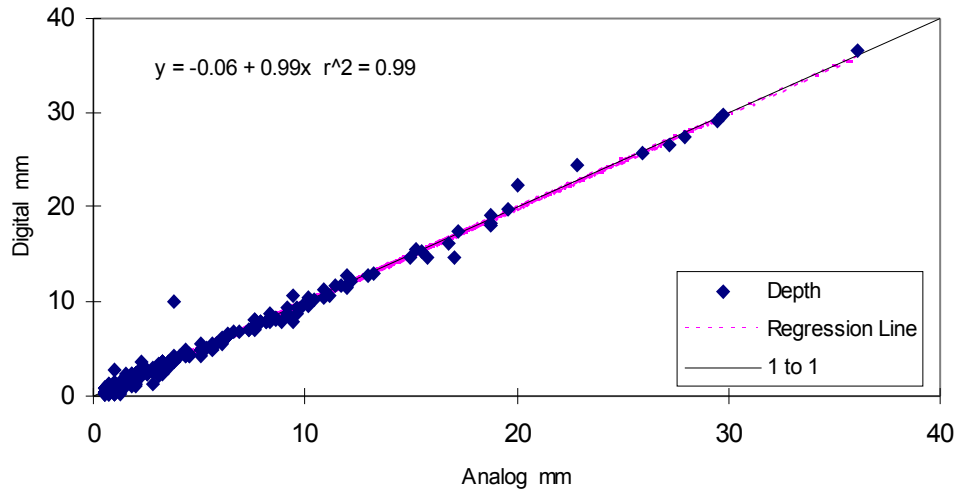
Time-depth pairs that are digitized from a chart at intervals

less than 5 minutes combine to produce peak intensities that are artificially high.

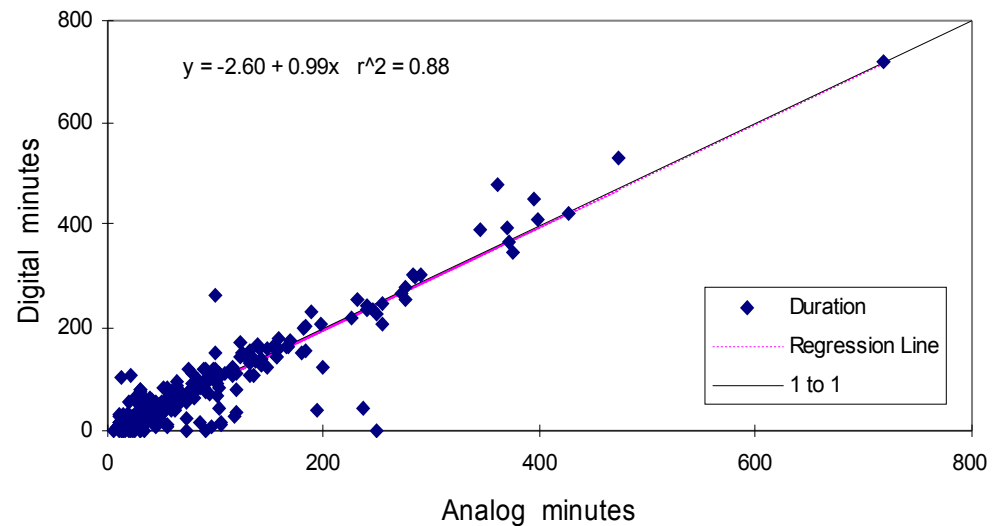
The overestimation of peak intensities will have implications for rainfall-runoff models which use time-depth pairs as model inputs.

Analog and Digital Comparison: Regression RG81 284 events

Depth

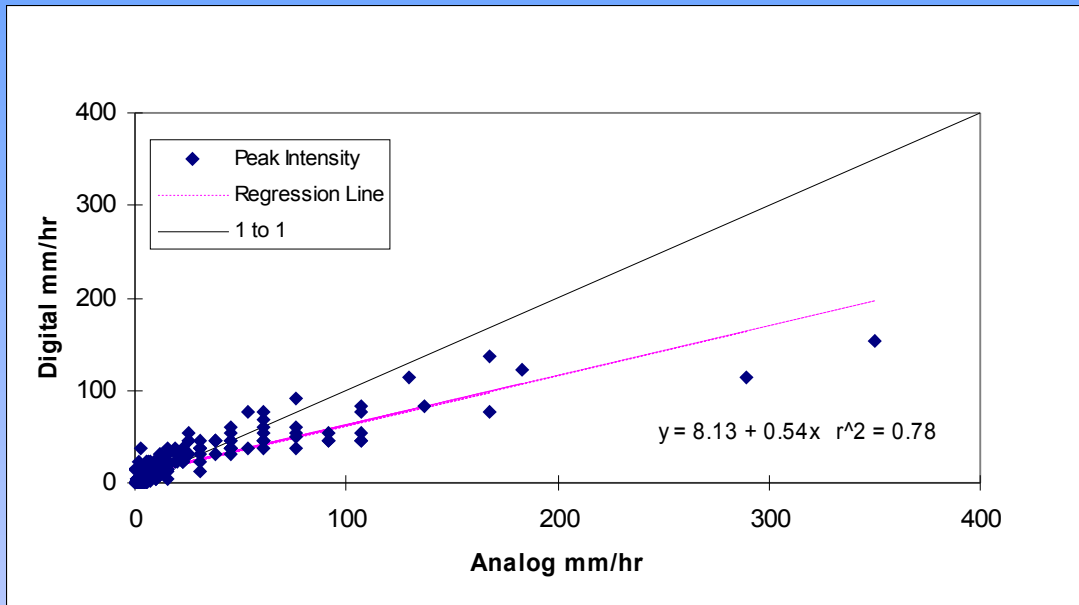


Duration

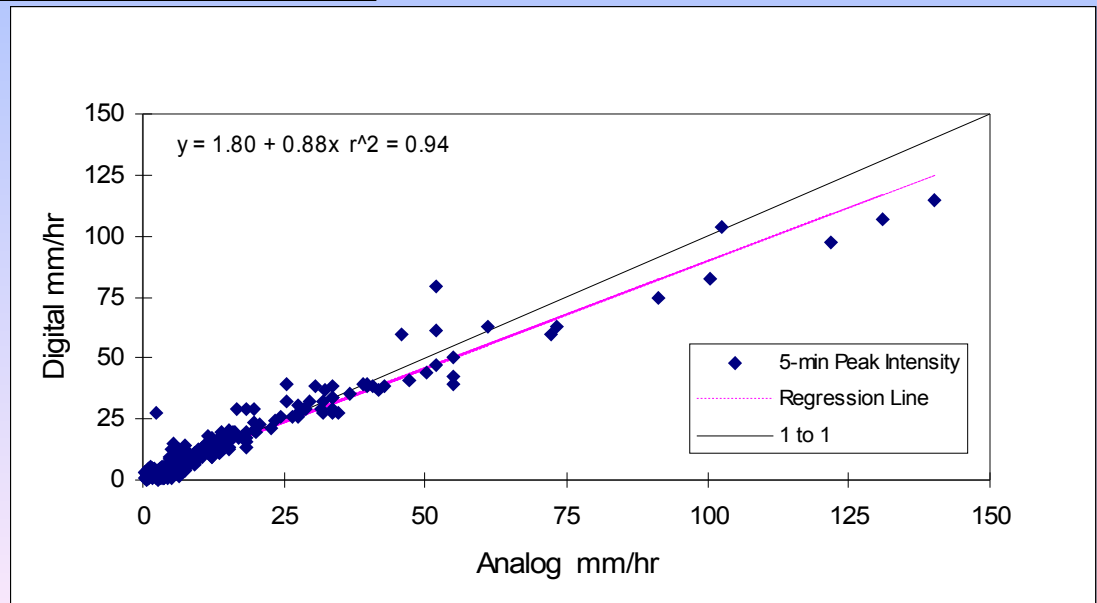


Analog and Digital Comparison: Regression RG81 284 events

Peak intensity

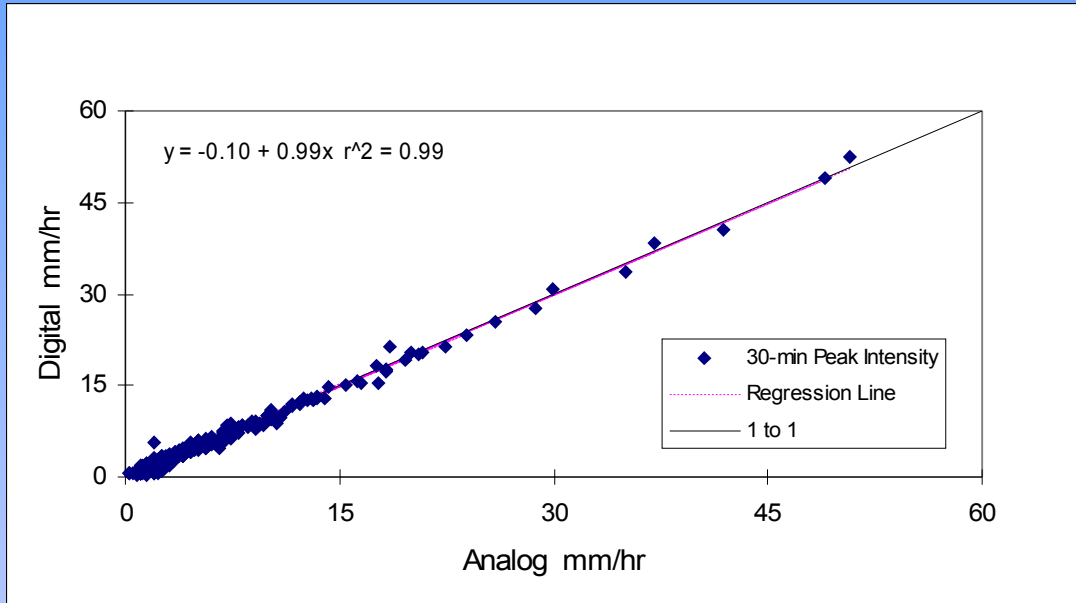


5-min Peak Intensity

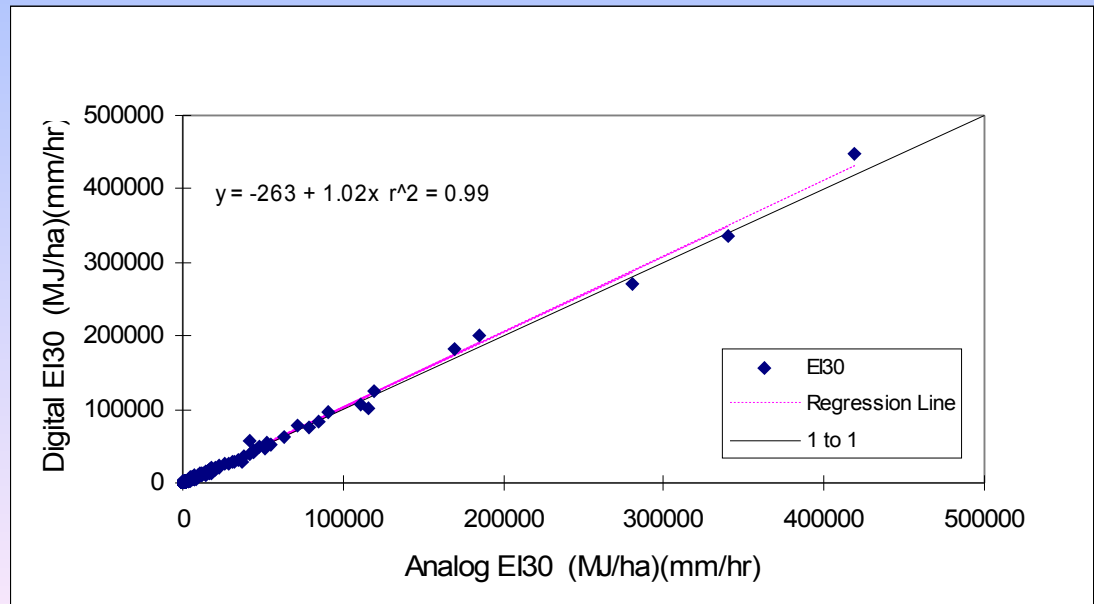


Analog and Digital Comparison: Regression RG81 284 events

30-min peak intensity



EI30



Analog and Digital Comparison: Regression

Intensity							
Gage	N	Peak		5-min		30-min	
		r^2	slope	r^2	slope	r^2	slope
4	239	0.84	0.75	0.96	0.93	0.99	0.99
13	259	0.83	0.89	0.95	1.08	0.99	1.06
42	271	0.84	0.58	0.98	0.92	0.99	0.96
44	281	0.77	0.68	0.95	0.94	1.00	0.99
46	244	0.84	0.71	0.96	0.91	0.99	1.02
60	256	0.81	0.81	0.95	0.98	0.99	1.04
68	272	0.79	0.62	0.95	0.87	0.99	0.98
80	236	0.82	0.64	0.95	0.91	0.98	1.05
81	284	0.78	0.54	0.94	0.88	0.99	1.00

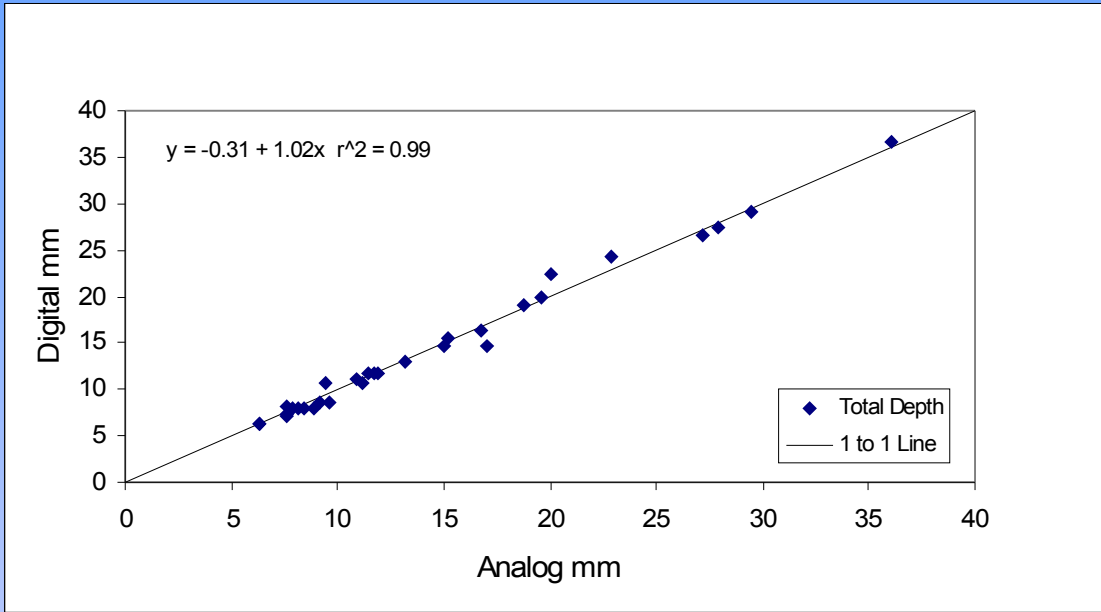
Modeling Implications: KINEROS

The rainfall-runoff model KINEROS was used to simulate runoff using parameters for two small watersheds on WGEW. LH106 is a 0.344 ha watershed nested within the larger 4.53 ha LH104. Rainfall intensity dominates the runoff generation process at the smaller scale, but channel losses control runoff at the larger scale.

Precipitation inputs for KINEROS runs were selected from events measured at raingage 81. Thirty paired events which had the highest peak intensities for events with over 6.3 mm total depth at both analog and digital raingages were selected.

We hypothesized that the higher peak intensities of the analog raingage would impact runoff at LH106 but not at LH104.

Modeling Implications: KINEROS Precipitation Input 30 Events

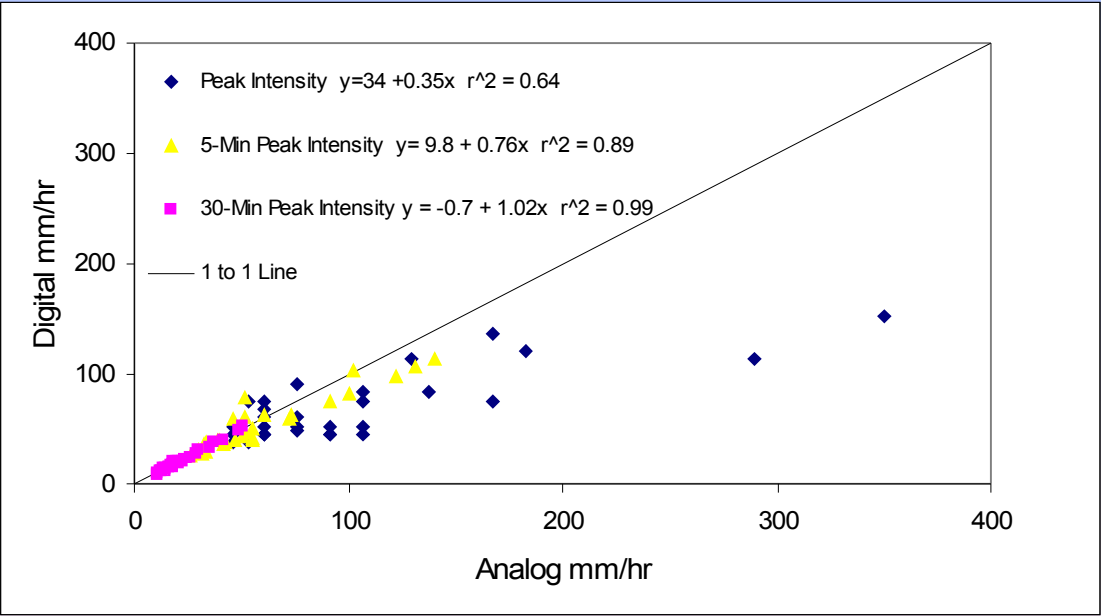


Depth

Depth mm		
	Min	Max
A	6.35	36.07
D	6.35	36.58

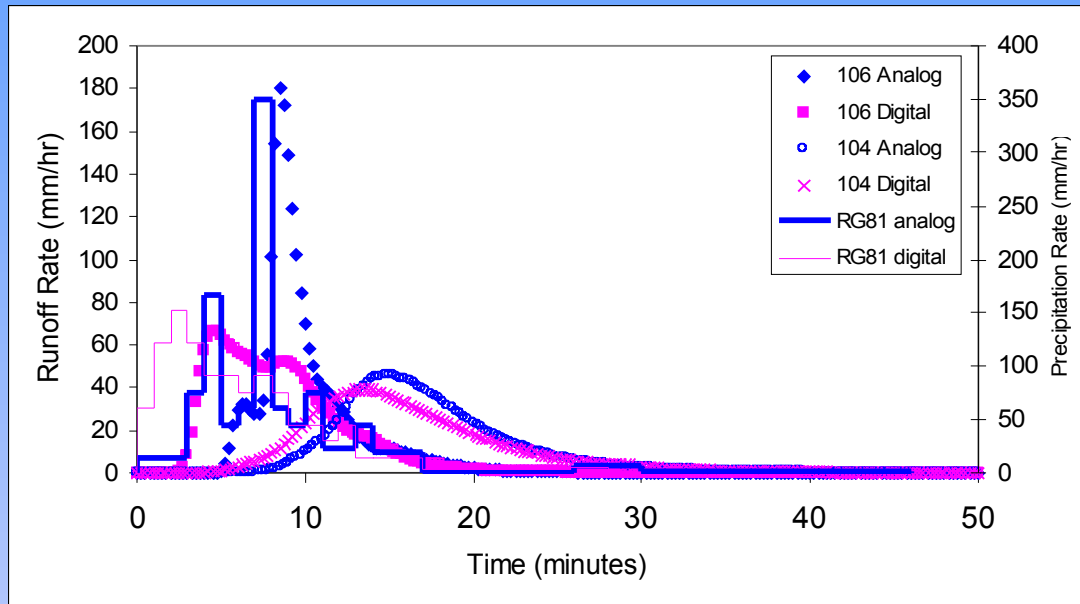
Peak Intensity mm/hr		
	Min	Max
A	45.72	350.52
D	38.10	152.40

Intensity

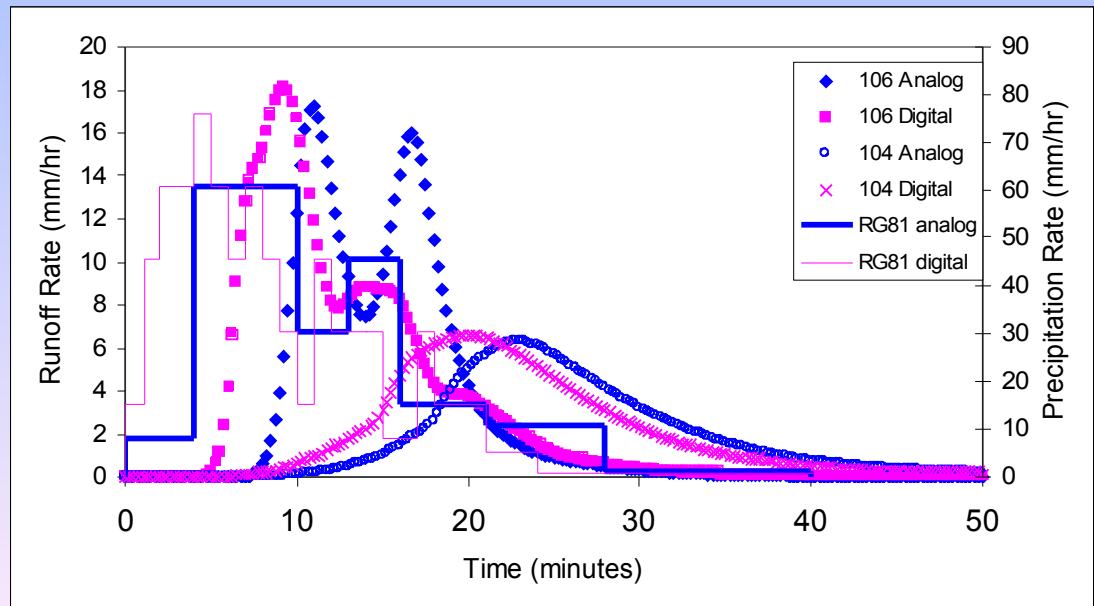


Modeling Implications: KINEROS Runoff Output

July 15, 2001 RG81

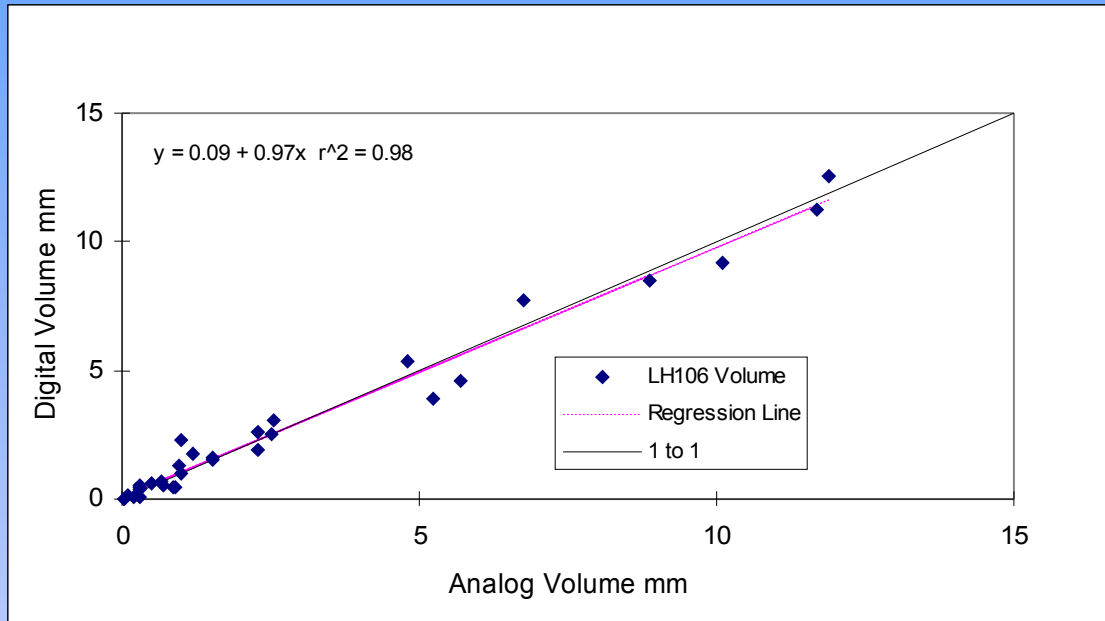


August 8, 2002 RG81

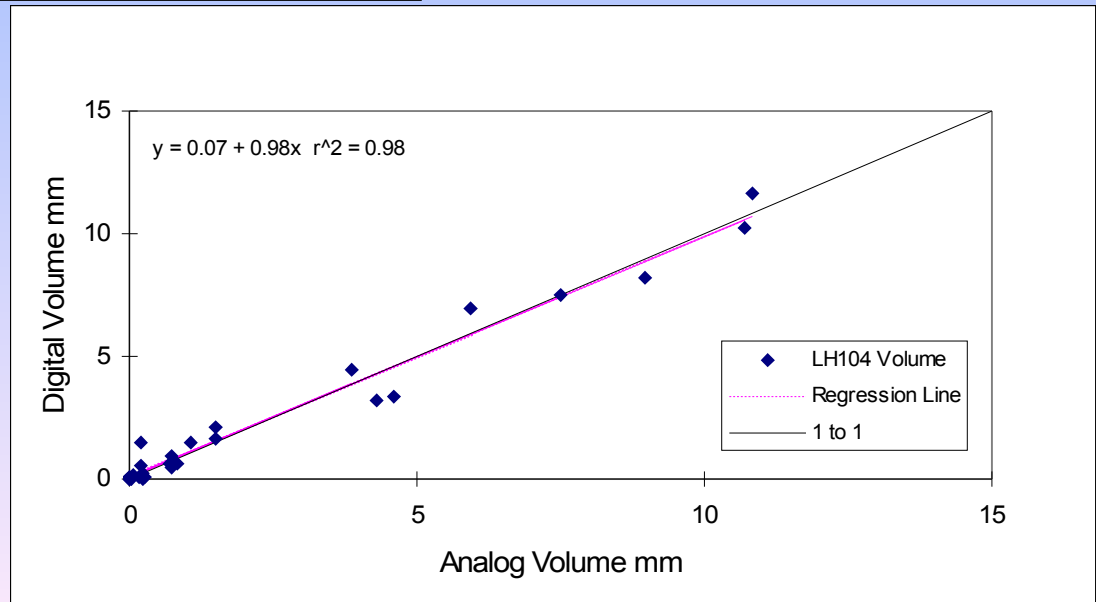


Modeling Implications: KINEROS Runoff Volumes

LH106, 0.344 ha

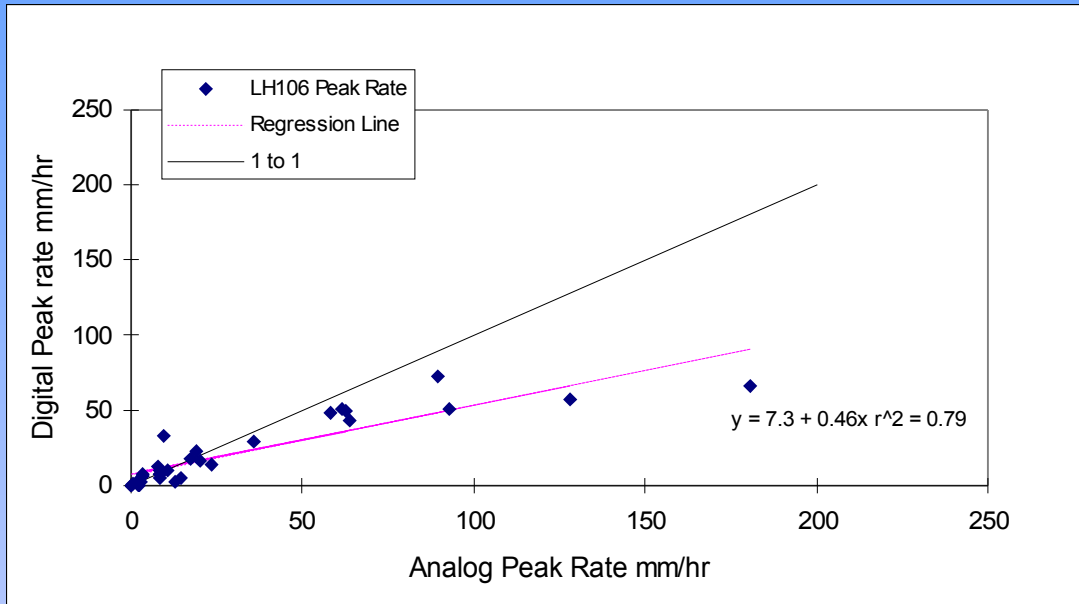


LH104, 4.53 ha

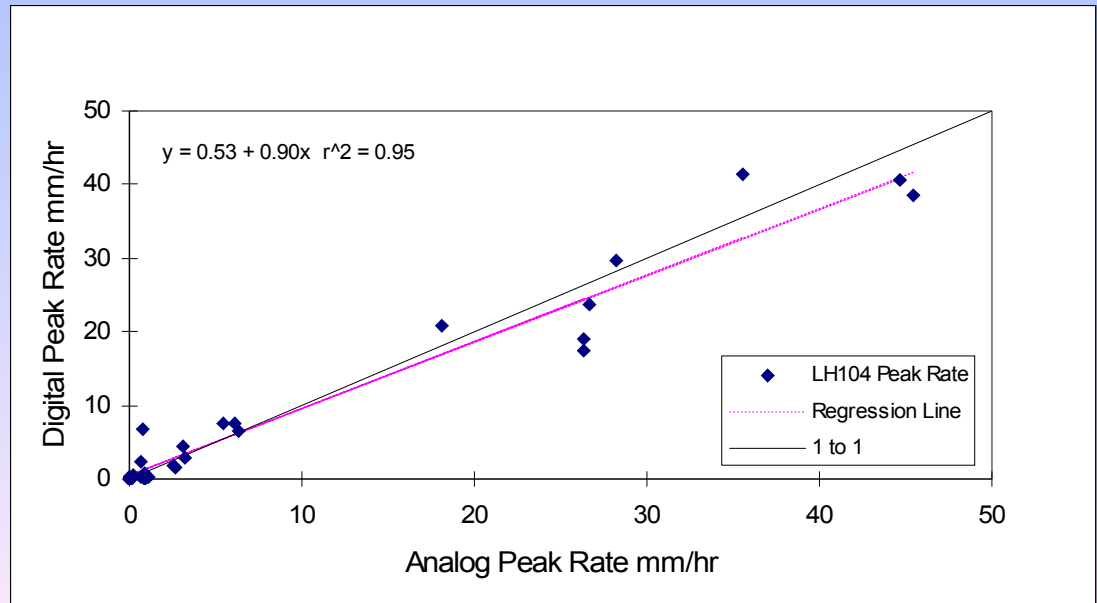


Modeling Implications: KINEROS Runoff Peak Rates

LH106, 0.344 ha



LH104, 4.53 ha



Conclusions

- 1. Analog and digital raingages are statistically equivalent for various measures of event precipitation: e.g. depth, duration, 5- and 30- minute peak intensity and EI30.**
- 2. Artificially high analog peak intensities significantly impact simulated runoff at small scales, but not at larger scales due to damping by channel effects.**
- 3. Hydrological modelers must be aware of the implications of differences in gage measurements, especially when evaluating changes over time during which transitions in gage type occurred.**

A dramatic landscape photograph featuring a vast field of tall, dry grass in the foreground. In the background, there are rolling hills and a range of mountains under a heavy, dark, and stormy sky. A bright, rectangular light source is visible behind the clouds on the horizon, creating a strong contrast with the dark sky. The text "THE END" is centered over the horizon line.

THE END

Photo courtesy of Linda Kennedy